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A STUDY OF MONTEREY CYPRESS PESTS

AT STANFORD UNIVERSITY

AND VICINITY

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Stanford University, California
January, 1928

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Introduction

During the past several years an epidemic of considerable importance has been ravaging the Monterey cypress on the Peninsula. These trees have been suffering from infestations of several kinds, especially in the vicinity of Palo Alto. The loss has been very heavy in young cypress and especially the older and mature trees. Hedges as well have been spotted and made to look unsightly by dying trees.

The present investigation was started on October 10, but as yet no final conclusions have been ascertained. Several species of insects have been found to attack the living trees. Some of these are primary; others come in after the trees had been severely weakened. A fungus disease has also been found and its presence seems to be of considerable importance.

Mr. F.B. Herbert, in his paper on Cypress Bark Scale, has attributed much of the damage in Monterey cypress to this insect. Although Cypress Bark Scale, Ehrhornia cupressi (Ehrhorn), has been found to be plentiful in this vicinity, it cannot be cited at present as the chief cause of injury, especially among the younger trees.

Each insect will be spoken of separately in this paper. Although this serves only as an introduction to an important study, there are certain salient factors that are of interest economically.

Cypress Bark Scale, Ehrhornia cupressi (Ehrhorn)

This insect was found commonly on almost every tree examined. The infestation was particularly bad in some trees and negligible in others. The old trees especially seemed to be more susceptible. Taken as a whole, however, this insect was not found to be in such numbers to cause the death of hundreds of trees as is the case in this vicinity.

Another scale insect, Diaspis carueli Targ., of much less importance, was found on the foliage of several trees. This insect occurs apparently only on weakened trees. Its damage is not primary.

Monterey Cypress Barkbeetle, Phloeosinus cristatus (Lec.)

This insect is found to be very abundant especially in the older trees. The damage that is done by it is very serious, but it apparently is not primary in its killing ability. On the contrary, it attacks only those trees which have become severely weakened by drought, old age, or the infestation of other insects or plant disease. It frequently attacks the younger trees but not unless their resistance has been lowered severely. Phloeosinus cristatus (Lec.) causes

the heaviest losses among the old Monterey cypress trees. At least 80 per cent of the dead trees that were examined on the Stanford campus and vicinity had either the emergence holes of this insect or developing broods. Eight out of ten trees examined on Frenchman's Hill, northwest of Mayfield, had emergence holes of Phloeosinus. This indicates that the insect is a final killer of the old trees which had been severely weakened before they came in. Many of the mature trees appeared to be very unhealthy by the presence of discolored foliage. They were examined and from 30 to 50 per cent of them had developing broods of Phloeosinus.

Little is known of the biology of this insect. Its life has apparently never been worked out. Some valuable information was obtained from the data that were gathered during the present season, but no complete cycle could be followed through in such a short period. Broods in all stages of development were found on October 10, when the first examinations were made. The broods were in practically the same condition on December 15 when the last observations were made. New attacks were still being made and new broods started. The prepupal larvae that were found on the 10th of October were still in that condition. Pupae had not been found up to that time. The adult beetles, however, were seen either extending galleries and laying eggs or boring in the twigs of young trees.

Considerable damage was done to the young cypress twigs last summer by a flight of Phloeosinus. Numbrous dead twigs were to be seen on many of the young trees. Another flight which was first noted on October 31 killed many of the twigs between that time and December 15 when they were still found in them. The beetles usually bore into twigs of about 1/8 of an inch in diameter. They always bore downward from the point of entrance, eating out the woody tissue. It is definitely proven that they are feeding on the plant tissue, for examination of the intestinal contents revealed bits of woody material. It has not yet been determined why the insects feed in the young twigs, and no explanation is offered. When Phloeosinus cristatus bores into the trunks and extends its gallery it also feeds on the tissue. An examination of the intestinal contents of beetles taken from the galleries showed the presence of quantities of woody tissue.

The brood galleries of Phloeosinus cristatus (Lec.) extend longitudinally up the trunk and are as a rule from 2 to 6 inches long. A nuptial chamber is hollowed out just inside the entrance hole. The male and female insects are frequently found in it. The gallery is extended up from this chamber and eggs are laid at intervals in niches hollowed out by the female. Often the gallery extends half to $\frac{3}{4}$ inch below the nuptial chamber. The male is usually found at the entrance in most new galleries, and the female is found extending the gallery and laying eggs. When the eggs hatch the larvae bore at right angles to the egg gallery. Each one works separately and eats out the cambium in its path. By the time the larvae are fully grown, their galleries are anywhere from 5 to 8 inches long. They then bore for a short distance into the wood and hollow out a pupal cell which is always parallel to the trunk or branch in which they are working.

Cypress Cone Moth (Carpocapsa cupressana (Kearfott)

Another insect which is of very great importance in the young cypress trees is the Cypress cone moth. The larvae of this moth bore into the trunks, usually at the base of branches. They feed in the bark tissue, winding here and there until they are ready to pupate. They then come very near to the outer bark and hollow out a pupal chamber, line it with silk, and rest until they pupate. The pupa consists of a small brown chrysalis.

The form of material found this fall consisted of larvae in all stages. One chrysalis was found on the 27th of October. There was evidence of heavy emergence in the tree where the chrysalis was found, but this particular one was probably held over from a warmer brood. It had been retarded in development for some reason. No pupae were found from the broods that developed this autumn, but a large percentage of them were full grown and in the pre-pupal stage by December 15.

Fungus Disease--Coryneum sp.

A disease of considerable importance was noted to cause a drying condition especially around the base of branches where they join the trunk. It is first indicated by a browning of the outer bark. In later developments the bark and cambium are entirely killed, giving a blighted appearance similar to the disease of pear or apple trees. The infestation gradually extends around the trunk and often runs into the ground.

On October 19 branches containing this disease were taken from the Palo Alto High School grounds. These were brought into the laboratory, and as directed by Professor McMurphy, bits of the diseased inner bark were planted in bean agar culture media. After 48 hours a healthy, white, flocculent mass of fungus had developed from each piece of bark. On November 1 transfers of the fungus were made to bean agar slants in order to secure pure cultures. Within 24 hours a white flocculence had developed in each tube. By the 8th of November black masses of spores had formed, borne in acervuli. The spores were examined and found to belong to the genus Coryneum. They are borne on conidiophores in a special spore-bearing mass of mycelium, the acervulus. The spores are five-septate. This divides them into six compartments, the middle four of which are granular and pigmented dark brown.(See Plate I)

On November 11 the fungus mycelium and conidiospores were inoculated into branches of two young cypress trees in order to find out whether it was the organism that was the cause of trouble. This was done by making slits in the bark with a sterilized knife, then placing the mycelium or conidiospores under the slit, after which the slit was pressed down tightly. Four inoculations were made, three of which were made only with mycelium, the other with conidiospores. Since that time the development has been very slow, but present conditions indicate that the fungus is infecting the branches where it was inoculated.

Dr. Meinecke of the U.S. Forest Service, who was present at an informal luncheon held in the Stanford Union about the 21st of November, mentioned while visiting with Professor McMurphy that he had been studying this disease of cypress and had been successful with his inoculations. He said that it grew quite readily. He reported the fungus to be nespecies of Coryneum closely related to peach blight, Coryneum beyerinckii.

During November cultures were planted from material collected in very badly infected young cypress trees surrounding a field directly west of the main group of university buildings. Other diseased branches from cypress trees near Lake Lagunitas were also plated. The same fungus developed in each instance, indicating that it is quite generally distributed in this vicinity.

On November 18 parts of a fresh, uninfected cypress branch ½ of an inch in diameter were put into test tubes with a few drops of distilled water absorbed in cotton and sterilized in the autoclave at 5 lbs. pressure for 20 minutes. Each part was about 4 inches long. After the sticks had been thoroughly sterilized, they were inoculated with spores of Coryneum to find out how fruiting bodies occurred in the branches. In a few days a white flocculence was found to be developing in each stick, indicating that the spores had germinated. On December 13, acervuli with spores were present on each of the sticks.

On December 2 diseased branches of creeping juniper and Sequoia sempervirens were taken into the laboratory and bits of tissue were plated in agar media concocted of a tea from cypress bark. By December 5 a white fungus had developed from each of the cultures. Transfers were made into slants. It had not developed enough by December 15 to determine its identity. It may be the same as the fungus found on cypress.

Correlation Between Cypress Cone Moth and Fungus Infestation

With very few exceptions, on at least 50 different diseased trees examined, the fungus was found to be closely associated with the work of the cypress cone moth. The fungus had completely killed the bark and cambium and extended some distance up and down the trunk where the infestation of cypress cone moth larvae was found to be serious. In some cases the larvae of the moth had recently entered the bark and only a slight browning was apparent. The fungus was found in two trees where there were apparently no insects or evidences of their work.

Whether the insects alone are responsible for the fungus infection by carrying spores, or whether the wounds caused by the larvae boring into the bark serve as openings for fungus spores that may be present in the air, has not yet been determined. Experiments will be carried on to determine this point.

On November 29 a larva was caged in a small area by gluing a piece of cardboard in the form of a rectangle to the trunk. A thin cover glass was glued over the cage to prevent the larva from escaping. The larva commenced to bore into the bark surface and within a week had eaten all the outer bark from the caged area. No fungus infection was noted up to December 15. Various cuts and bruises were made on uninfected branches at the same time to see if they will be points of infection for the fungus, considering the possibility of spores being present in the air.

Summary

A study of the diseased and dying condition of Monterey cypress about Stanford University and vicinity between October 10 and December 15 resulted in finding out some of the principal causes. Several species of insects were found to do considerable damage: Two scale insects, Ehrhornia cupressi and Diaspis carueli, a barkbeetle, Phloeosinus cristatus, and a moth larva, Carpocapsa cupressana. In addition to the insects a fungus disease, Coryneum sp., was found to be very important among theyounger trees, causing the bark and cambium at the base of branches and trunk to turn brown and die. A short study of the correlation between insects (especially Carpocapsa cupressana) has not resulted in anything definite as yet.

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Young cypress showing characteristic twig pruning caused by Phloeosinus cristatus. This attack occurred in August 1927. Photo by H. E. Burke.
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